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Title: BIA Shipping Configuration Temperature Prediction

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BIA Shipping Configuration Temperature Prediction

with ANSYS

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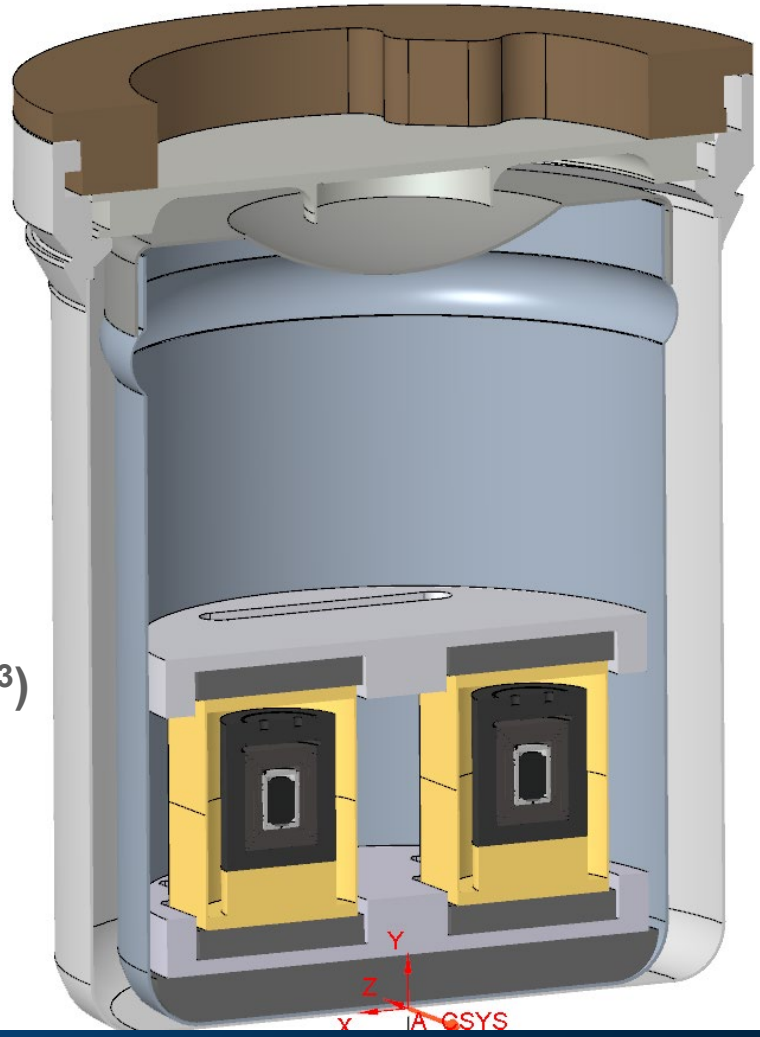
Purpose

- Determine the internal and external temperature of the BIA shipping configuration
- Ensure external SAVY temperature is compatible with drum packing materials

ANSYS Thermal Model

- **3D CAD models of the nested shipping configuration to ANSYS from Creo/Parametric**
- **Conduction heat transfer**
  - BIA to fixture
  - Fixture to slip lid container
  - Bia to graphite felt
  - Slip lid to SAVY
  - Air to inside of slip lid
  - Air between slip lid and SAVY
- **Surface to Surface (cavity) radiation – view factors calculated**
  - Aeroshell exterior to BIA internal
- **Bonded contact idealization (perfect contact)**
- **Heat rate of 1 W applied to each LWRHU pellet as energy generation (W/m^3)**
- **Quiescent convection on the exterior of the SAVY**
- **Thermal models**
  - Steady state
  - Transient (time-dependent)

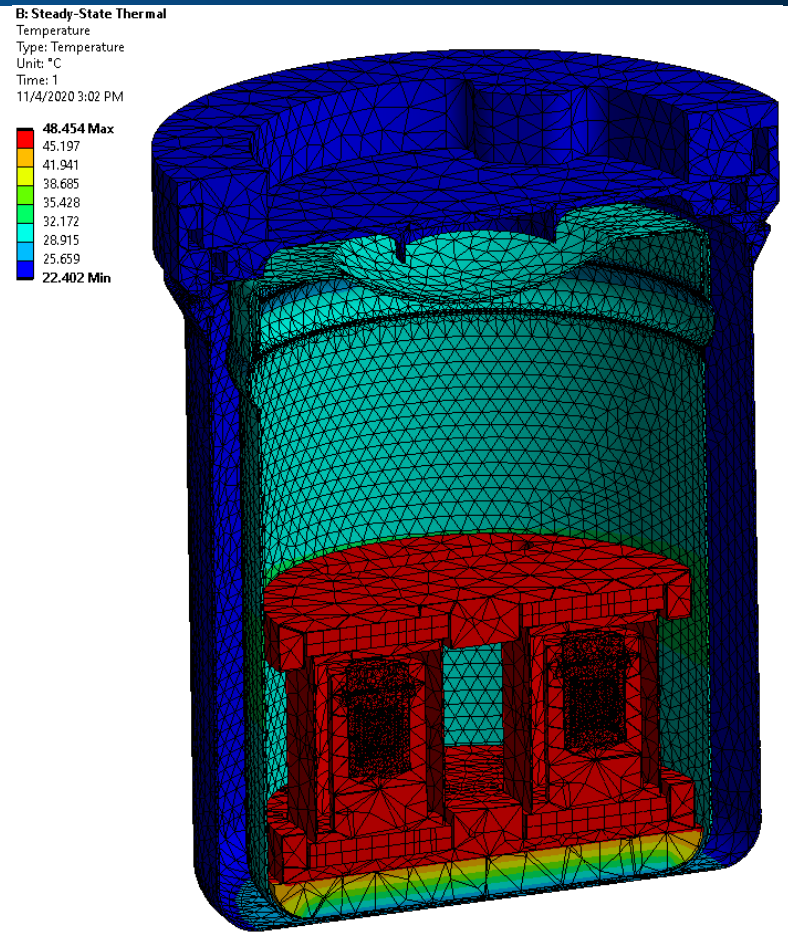


Material Models

- **Temperature dependent thermal properties**
  - Thermal conductivity
  - Specific heat
  - Emissivity
- **Aluminum 6061**
  - ANSYS
- **Fine Weave Pierced Fabric**
  - ORNL-TM-8949 R1, *Isotopic Space Power Materials Handbook*
- ***Pyrolytic graphite***
  - *ANSYS*
- ***Pu-238 Oxide***
  - ORNL-TM-8949 R1, *Isotopic Space Power Materials Handbook*
- ***Stainless Steel (300 Series)***
  - ANSYS
- **Graphite Felt**
  - *Thermal Conductivity of Graphite Felt at High Temperatures* – Chahine et. al, 8th Australasian Heat and Mass Transfer Conference, 26-29 July 2005

ANSYS Steady State Result

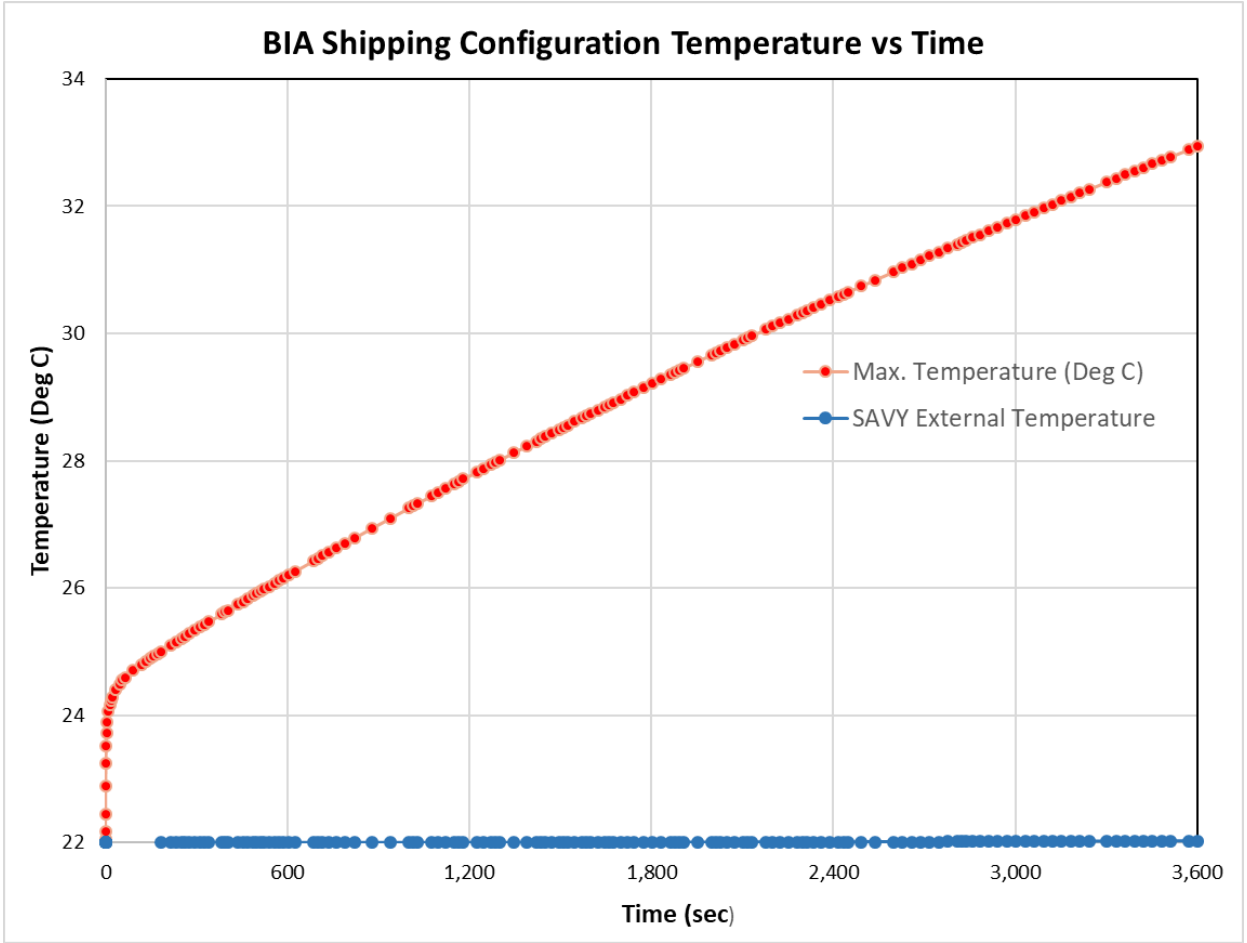
- Initial temperature of 22°C
- Maximum model temperature - 48°C (Pellet)
- SAVY external temperature 22°C
- Steady state model validity can be checked by summing the energy in and energy out ($E_{in} – E_{out} = 0$)
- Energy balance checked using ANSYS results probes
- 2W - 4.13e-3W - 5.16e03W – 3.26e-3W + 5.14e-3W= -2.0087
- Solution error magnitude = .008 W
- Solution error = 0.4%



Steady State Temperature Results

ANSYS Transient Result

- Transient run for 1 hr. (60 min)
- Steady state values not reached at the end of the solution due to the small heat load from the LWRHUs
- Exterior of the SAVY remains at ambient temperature throughout the run



Conclusions

- ANSYS thermal model of the of the shipping configuration shows the external surfaces of the SAVY remains at ambient temperature
- Temperature gradients within the SAVY are shown in the adjacent figure.
- It would be prudent to handle the inner slip lid and the fixture components with heat resistant gloves when initially unloading the BIA RTGs from the shipping configuration based on the steady state temperature results